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Agricultural Memorandum No. 358

Machinery Work-Days available for the cereal harvest in the Eastern Region

BY C V SMITH

INTRODUCTION

If one attempts to service the requirements of industry for meteorological advice, then one can seldom indulge in the luxury permitted the pure scientist who can, and often indeed must, continue working on a particular line of inquiry until he can prove his answer (a unique solution?) up to the hilt. By contrast, the applied meteorologist must often judge between a number of feasible solutions to a problem, in the absence of sufficient data for any one of them to be proved unequivocably correct. The delay of a year, say, to collect such data is likely to prove unacceptable. The emphasis is on providing working answers with a minimum of delay, and on informed judgement. In agriculture, if the advice is not timely, then a complete season may be lost.

Such a preamble is relevant to the current problem which concerns the time likely to be available over the months of July to October to harvest the cereal crop. Recent years have shown the difficulty and consequences in some seasons of field working under wet soil conditions in the autumn. Since the crop is likely to have synthesised all the dry matter that it is going to by early July, we have the possibility of harvesting an early but moist crop (at say 27% moisture content - wet weight basis) and in effect buying valuable field working time in say July and August, through the use of grain drying equipment. Timeliness of the late summer, early autumn cultivations for the following crop offers the possibility of increased grain yields through selection of the optimum sowing date and through a minimal amount of damage to soil structure, since heavy equipment (either for drainage or cultivation) should now, in most years, be moving over the soil which has not yet returned to field capacity. /We have here the paradox that it is in a wet summer that one should take an early harvest, if difficulties of field work in the autumn are to be avoided/. In addition to these deferred advantages, we have the positive advantage with the current crop of smaller field losses of grain with the earlier harvest. Among the reasons for this are purely meteorological ones. In both July and August for example, there are some 2 to 3 days on average when the wind will be gusting to gale force and buffetting the standing crop. In September, we can expect 3 to 4 such days each month, and in October 4 to 5.

As far as one can tell, there is no information in the literature on the rate of drying of a standing field crop of grain and environmental parameters; and in what little literature there is on this subject, one must suspect that the answers given have in effect been assumed. We have for example the

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one to one relationship between the moisture content of grain at equilibrium with its ambient relative humidity. But this only indicates the moisture content of harvested grain in the limit and does not give the relationship between grain moisture and the environment under any other conditions (which at least one writer would have appeared to have supposed). The drying of harvested grain involves complex physical processes. For the standing crop, able to translocate water, we have additional complicating factors.

The problem

We assume our combine will cope with standing grain at 27% moisture content-wet weight basis (or less). The equilibrium relative humidity of grain at 27% m.c. is of the order 95% RH, and we assume that provided the standing crop is not superficially wet from recent rain or dew, then conditions will always be right for combining, if the combine can go (and perhaps even that moisture will be moving out of the crop).

The problem is reduced to assessing the time during which a standing crop will be dry ie the crop does not have its surface wet from rain, recent rain or dew.

The data

Ag.Mem.147 - Humidity in the Eastern Region over the corn harvest period - presents information on the observed relative humidities, in various ranges of values, for the months of August, September, October. The initial question was whether this data could be extended back into July without reference to the original hourly observations, and counting over a 10 year period.

The mean 1300 hours R.H. at the station concerned (Mildenhall) is available for each month. Plotting these data against the percentage of time in the month (all hours) when the hourly R.H. was $\geq$ 90% gave a straight line relation (Fig.A). Extrapolation seemed justified and a plot of the mean 13 hour R.H. for July gave an estimate of the percentage of time the R.H. in July was (on average) likely to be $\geq$ 90%.

A plot of the percentage of time, for each month when the R.H. (all hours) was $\geq$ 90% against the percentage of time, for each actual month when the R.H. (between the hours of 1000-1800) was $\geq$ 90% is shown in Fig. B. Extrapolation to the July value was again made.

We now have available for each month, information on the average percentage of time when the R.H. is $\geq$ 90% between the hours of 1000-1800 GMT.

Ag. Mem. 33 - Duration of surface wetness - indicates, for 10 day mean periods, an almost one to one relationship between observed hours of wetness (from a wetness recorder) and hours of high humidity. A high humidity was here defined as one $\geq$ 90%.

Since we are concerned with long period averages in our data, the simple conversion was made from hours of high R.H. ($\geq$ 90%) to hours of surface wetness. Over the day-light hours 1000-1800 GMT the situation is:

	July	August	September	October
Percentage of hours wet	5%	6%	8%	15%

Now Hydrological Memorandum No. 19 summarises rainfall data over the Eastern Region for a 35 year period. For the months of July, August, September, October, we find on average 12 rain days (rainfall $\geq$ .005 inches) in each month.

If for want of any detailed analysis of the timing of rain during the 24 hours of the day we assume that rainfall is evenly distributed throughout the day, then on 4 days each month, it will rain during the hours of 1000-1800 GMT. Let us assume the occurrence of rain during these daylight hours inhibits any combining on these days.

The situation now is

	July	August	September	October
Number of days in month	31	31	30	31
Number of working days after allowing for rainfall in the period 1000-1800 GMT	27	27	26	27

It is a reasonable assumption that in July and August any overnight dew will have been driven off the crop by 1000 GMT on most days. This in fact is why the time of 1000 GMT was chosen in the initial analysis.

So in fact the 5% of time that the standing crop is wet during the hours 1000-1800 GMT is due essentially to rainfall in the months of July and August. Because of the similar number of raindays in each month from July to October, the inference may be made that for a similar 5% of the time (during the hours 1000-1800 GMT) in the months of September and October, crop wetness is due to rainfall. The excess over 5% of the time arises primarily from dewfall. For September and October we have now to interpret the effect on work days lost of wetness due to dew for 3% and 10% of the time between 1000-1800 GMT respectively. In September this amounts to about 7 hours and in Octover about 25 hours.

Now if we accept that this time is most likely to be associated with one or two weather situations which give rise to prolonged wetness due to dew, rather than some wetness from dew after 1000 GMT on most days, and if we accept that a crop that is wet until some time into the afternoon may be regarded as a non-starter for combining on that particular day, then we could interpret our hours of wetness from dew as suggestive of a further 2 days and a further 6 days lost to combining in September and October respectively.

The situation now is:

	July	August	September	October
Number of days in month	31	31	30	31
Number of working days after allowing for rainfall in the period 1000–1800 GMT	27	27	26	27
Number of working days after allowing for rainfall and dew in the period 1000–1800 GMT	27	27	24	21

Comparison with the independent assessment of Gang Work Days in the Eastern Region for light, medium and heavy land (and which incidentally will include now the possibility of field cultivations) suggests that the final estimate of average combining days is certainly not outrageous.

Gang Work Days – Eastern Region

	July	August	September	October
Light Land	26	26	24	22
Medium Land	25	25	24	20
Heavy Land	24	24	24	17

Now it could be argued that in view of the rate of working modern combines, that the difference between the number of combining days available in July and October is not significant for the individual grower. This may be true if we look at the cereal harvest in isolation. But as soon as we take some broader perspective and see the cereal harvest in its place in the cycle of work in the farming year, then the situation changes.

If, as experience suggests, we associate the return to field capacity with the onset of difficult and damaging field working conditions then it is worthwhile now to repeat some of the data reported in Ag. Mem. No. 269 – Sample decades for return to field capacity.

The distribution about a mean date of return to field capacity for a 10 year sample period is as follows:

Mean Annual Rainfall	Earliest	2	3	4	5	6	7	8	9	Latest
20 inches	0.20	N.15	N.29	D.7	D.16	D.26	J.7	J.19	F.1	F.24
22 inches	0.5	0.31	N.14	N.23	D.1	D.9	D.20	D.31	J.15	F.1
24 inches	S.21	0.17	N.2	N.11	N.19	N.28	D.8	D.18	D.31	J.18
26 inches	S.7	0.5	0.18	0.29	N.9	N.19	N.28	D.9	D.21	J.7
28 inches	A.25	S.23	0.7	0.18	0.29	N.9	N.18	N.30	D.12	D.29

A = August O = October D = December
S = September N = November J = January F = February

The message is now clear. Over a substantial part of the Region, a return to field capacity will have been achieved in late October in 5 years out of 10. In 3 years out of 10, the date is put forward to early or mid October. Time in hand over the months of August and September for field work is now almost an essential for good management.

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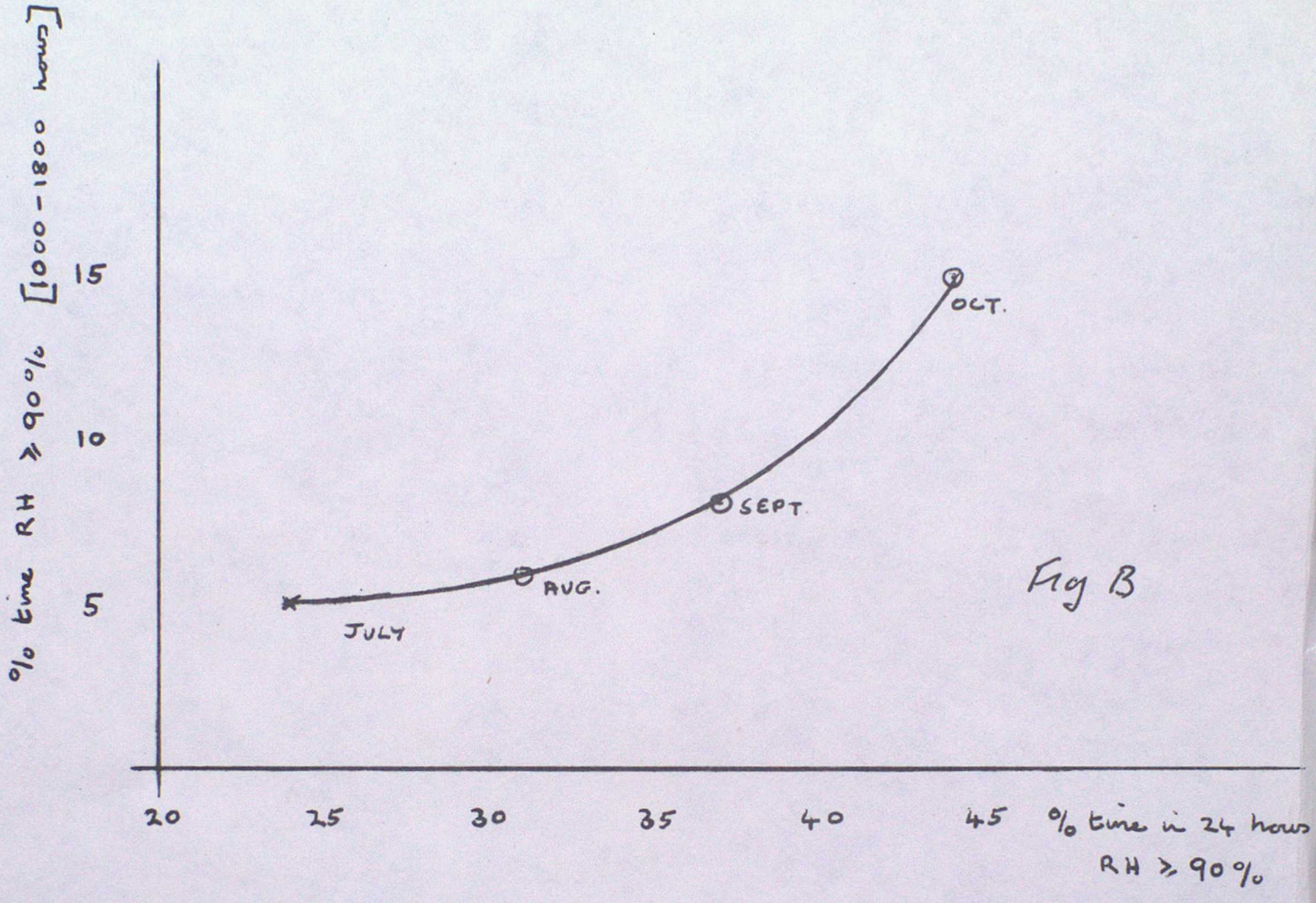
% time RH ≥ 90% [1000–1800 hours]
15
10
5
OCT.
SEPT.
AUG.
JULY
20
25
30
35
40
45
% time in 24 hours
RH ≥ 90%

Fig B

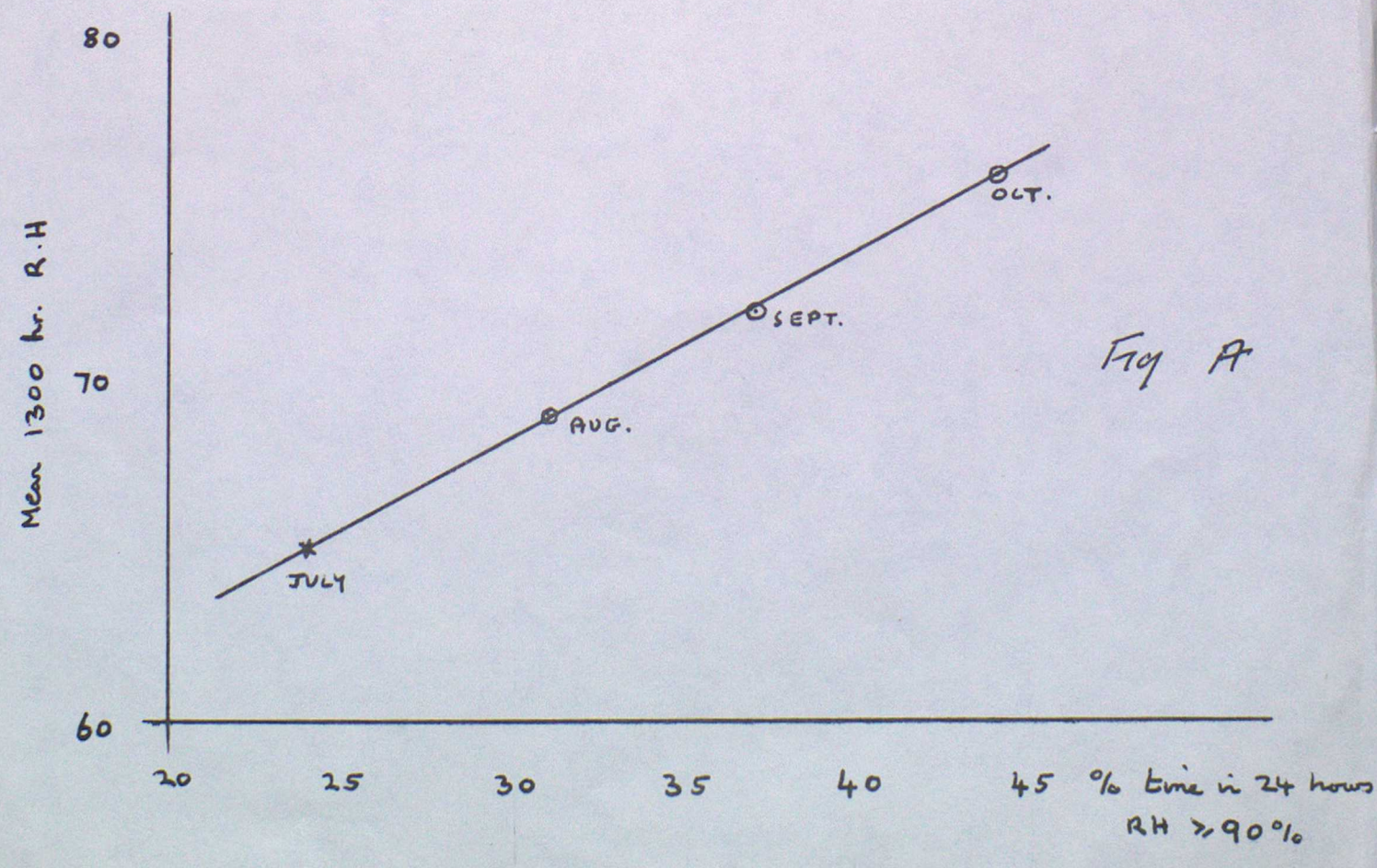
Mean 1300 hr. R.H
80
70
60
OCT.
SEPT.
AUG.
JULY
20
25
30
35
40
45
% time in 24 hours
RH ≥ 90%

Fig A